REMARKS

Claims 1-8 and 10-20 are pending. Claim 9 was canceled without prejudice in a previous Amendment. Claims 1-4, 7, 8, and 10-13 and the specification have been amended. Claims 16-20 have been newly added. No new matter has been added.

In the Final Office Action mailed December 10, 2008 (hereinafter the "Office Action"), the Examiner objected to the specification and rejected claims 1-15. Claims 12 and 13 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Application Publication No. 2003/0139167 filed by Ciccarelli (hereinafter "Ciccarelli"). Claims 1-4, 6-8, 10-11 and 14 were rejected under 35 U.S.C. § 103(a) as being obvious over Ciccarelli in further view of U.S. Patent No. 6,297,691 issued to Anderson (hereinafter "Anderson"). Claims 5 and 9 were rejected under 35 U.S.C. §103(a) as being obvious over Ciccarelli in further view of Anderson, in further view of U.S. Patent Application Publication No. 2004/0002323 filed by Zheng et al. (hereinafter "Zheng"). Claim 15 was rejected under 35 U.S.C. 103(a) as being obvious over Ciccarelli in further view of Anderson, in further view of Zheng.

Objection of the Specification

The Examiner objected to the specification. The specification has been amended in the enclosed substitute specification and redlined substitute specification to add headings to indicate the different sections of the specification. Applicant believes such amendment renders the specification in compliance with the requirements. Accordingly, it is respectfully requested that the objection to the specification be withdrawn.

Rejection of Claims 12 and 13

Claims 12 and 13 were rejected under 35 U.S.C. § 102(e) as being anticipated by Ciccarelli. Applicant respectfully disagrees with the basis of the rejection and requests for the Examiner's reconsideration and further examination of the claims in view of the remarks below.

Claims 12 and 13 have been amended to more clearly recite the claimed subject matter, and the amendments are not in response to the rejection of the claims.

Claim 12

Claim 12 recites a method of iteratively compensating a phase imbalance or gain imbalance in a receiver, the receiver utilizing a QPSK modulation and a modulation scheme based on a complex scrambling code, comprising the steps of: a) determining an error function on the basis of samples of phase compensated in-phase components and quadrature components of a revived I/Q modulated signal; b) filtering the error function; c) integrating the filtered error function; d) determining a modified error function by adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability; e) determining a corrected output signal of the I/Q components of the received signal on the basis of subsequent samples of phase compensated in-phase components and quadrature components of the received I/Q modulated signal and the modified error function; and f) returning to step a): and providing estimated and compensated I and Q components of an incoming I/Q modulated signal to a symbol synchronizer for synchronization.

Applicant respectfully submits that the Examiner erred in asserting that Ciccarelli discloses the limitations of claim 12. For example, the Examiner relies on paragraph 18 of Ciccarelli to show "determining an error function on the basis of squared samples of phase compensated in-phase components and quadrature components of a received I/Q modulated signal" as recited in claim 12 (Office Action, page 8). The Examiner also takes the position that the claimed limitation of "integrating the filtered error function" is disclosed by Ciccarelli in paragraph 54 (i.e., mixer), and that the claimed limitation of "determining a modified error function by adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability" is disclosed by Ciccarelli in paragraph 67 (Office Action, page 9). Nevertheless, there appears to be no evidence in the cited passages of Ciccarelli to support the Examiner's assertions.

To be sure, an excerpt of paragraph 18 of Ciccarelli is provided below.

> [0018] The present invention is embodied in an apparatus for the compensation of I-Q mismatch in a low IF or zero IF receiver and comprises first and second mixers having respective radio frequency (RF) inputs, local oscillator inputs, and mixer outputs. The RF inputs of the mixers are configured to receive modulated RF signals, the local oscillator of the first mixer is configured to receive an I local oscillator signal while the local oscillator input of the second

> mixer is configured to receive a Q local oscillator signal. The I and Q oscillator signals have substantially identical frequencies. The apparatus further comprises first and second filters coupled to the mixer outputs of the first and second mixers, respectively, to filter output signals from the mixer outputs and thereby generate I and Q output signals, respectively. Circuit differences in the first and second mixers and/or first and second filters result in gain and/or phase errors that result in mismatch in the I and Q output signals. The apparatus comprises a correction circuit to automatically apply a correction factor to at least one of the I and Q output signals to correct the gain and/or phase error by applying a multiplication factor to the at least one of the I and Q output signals to thereby generate a corrected signal.

Paragraph 18 fails to disclose, teach or suggest determining an error function on the basis of squared samples of phase compensated in-phase components and quadrature components of a received I/Q modulated signal as recited in claim 12. The passage talks about gain and/or phase errors in the I and Q output signals as well as correcting such errors by applying a multiplication factor to at least one of the I and Q output signals to generate a corrected signal. However, correcting errors in the I and Q output signals does not equate to or resemble determining an error function on the basis of squared samples of phase compensated I and Q output signals. There is no determination of an error function discussed or suggested in the passage. There is also no discussion or suggestion of squared samples of the I and Q output signals, let alone squared samples of phase compensated I and Q output signals.

An excerpt of paragraph 54 of Ciccarelli is provided below.

> [0054] The mixer (e.g., the mixer 120 in FIG. 3), low pass filters (e.g., the filter 120a) and ADC (e.g., the ADC 134) all contribute to mismatch in the I and Q circuits. These result in possible phase error and/or gain error between I and Q. To understand the signal processing by the mixers, let .quadrature. denote quadrature error, and let k denote gain error between I and Q. For the sake of mathematical analysis, consider that all of the error is lumped into the Q channel (i.e., the I channel is considered to be an accurate signal). The I and Q mixers in FIG. 5 may be conventional mixers, such as the mixers 20 and 22, respectively, discussed above with respect to FIG. 1.

Paragraph 54 fails to disclose, teach or suggest the limitation of "integrating the filtered error function" as recited in claim 12. As shown in Figure 1 and Figure 3 of Ciccarelli, there is no filtered error function provided to the mixer 120, mixer 20 or mixer 22 for integration. There is no filtered error function provided to any of the mixers in Ciccarelli. Further, as well

known in the art, in general a mixer combines two input signals to produce one output signal. A mixer however does not integrate an input signal to produce an output signal as a result of integrating the input signal. There is simply no disclosure of integrating the filtered error function in paragraph 54 of Ciccarelli.

An excerpt of paragraph 67 of Ciccarelli is provided below.

> [0067] In one embodiment, a pure tone RF signal may be injected into the wireless communication device to determine the gain and phase errors caused by circuit mismatch. With reference to FIG. 3, if there were no circuit mismatch, the I/Q outputs of the IC 130 would be precisely matched and no spectral image would be present, however, in actual application, the I/Q circuits have some degree of mismatch, resulting in a spectra similar to that illustrated in FIG. 2B. A digital signal processor (DSP) within the wireless communication device may be used to perform the calculations illustrated herein to determine the values for the compensation matrix. Alternatively, external circuitry, such as an external DSP, microprocessor, or the like may be used to solve the mathematical equations described above to determine the values of the compensation matrix of equation (5). When the values for the compensation matrix of equation (5) have been determined, data indicative of those values are stored within the wireless communication device and are applied to the I/Q signals to provide compensated versions thereof.

Paragraph 67 fails to disclose, teach or suggest the limitation of "determining a modified error function by adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability" as recited in claim 12. As can be seen, paragraph 67 talks about determining values of the compensation matrix of equation (5) and apply the determined values to the I and Q signals to provide compensated versions thereof. There is no discussion or suggestion of an integrated and filtered error function. Solving the compensation matrix of equation (5) is not adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability. Applying the determined values to the I and Q signals to provide compensated versions thereof is also not adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability.

Ciccarelli fails to disclose a combination of the limitations of claim 12 for at least the above reasons. Claim 12 is thus believed to be patentable over Ciccarelli.

Claim 13

Claim 13 recites a method of iteratively compensating a phase imbalance or gain imbalance in a receiver, the receiver utilizing a QPSK modulation and a modulation scheme based on a complex scrambling code, comprising the steps of: a) determining an error function on the basis of squared samples of phase compensated in-phase components and quadrature components of a received I/Q modulated signal; b) filtering the error function; c) integrating the filtered error function; d) determining a modified error function by adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability; e) determining a gain on the basis of a product of the modified error function and a factor; f) determining a corrected output signal of the I/Q components of the received signal on the basis of subsequent samples of phase compensated in-phase components and quadrature components of the received I/Q modulated signal and the gain; and g) returning to step a): and providing estimated and compensated I and Q components of an incoming I/Q modulated signal to a symbol synchronizer for synchronization.

Applicant respectfully submits that the Examiner erred in asserting that Ciccarelli discloses the limitations of claim 13. For example, the Examiner relies on paragraph 18 of Ciccarelli to show "determining an error function on the basis of squared samples of phase compensated in-phase components and quadrature components of a received I/Q modulated signal" as recited in claim 12 (Office Action, page 8). The Examiner also takes the position that the claimed limitation of "integrating the filtered error function" is disclosed by Ciccarelli in paragraph 54 (i.e., mixer), and that the claimed limitation of "determining a modified error function by adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability" is disclosed by Ciccarelli in paragraph 67 (Office Action, page 9). Again, as with claim 12, there appears to be no evidence in the cited passages of Ciccarelli to support the Examiner's assertions.

As explained above, the cited passages fail to disclose the claimed limitations. Paragraph 18 of Ciccarelli fails to disclose, teach or suggest determining an error function on the basis of squared samples of phase compensated in-phase components and quadrature components of a received I/Q modulated signal, as recited in claim 13. Paragraph 18 talks about

gain and/or phase errors in the I and Q output signals as well as correcting such errors by applying a multiplication factor to at least one of the I and Q output signals to generate a corrected signal. However, correcting errors in the I and Q output signals does not equate to or even remotely resemble determining an error function on the basis of squared samples of phase compensated I and Q output signals. There is no determination of an error function disclosed or suggested in the passage. There is also no discussion or suggestion of squared samples of the I and Q output signals, let alone squared samples of phase compensated I and Q output signals.

Paragraph 54 of Ciccarelli fails to disclose, teach or suggest integrating the filtered error function as recited in claim 13. As shown in Figure 1 and Figure 3 of Ciccarelli, there is no filtered error function provided to the mixer 120, mixer 20 or mixer 22 for integration. There is no filtered error function provided to any of the mixers in Ciccarelli. A mixer does not integrate an input signal to produce an output signal as a result of integrating the input signal. There is simply no disclosure of integrating the filtered error function in paragraph 54 of Ciccarelli.

Paragraph 67 fails to disclose, teach or suggest determining a modified error function by adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability as recited in claim 13. Rather, paragraph 67 talks about determining values of the compensation matrix of equation (5) and apply the determined values to the I and Q signals to provide compensated versions thereof. There is no discussion or suggestion of an integrated and filtered error function. Solving the compensation matrix of equation (5) is not adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability. Applying the determined values to the I and Q signals to provide compensated versions thereof is also not adding the integrated and filtered error function to a product of the integrated and filtered error function and a parameter based on speed and stability.

Ciccarelli fails to disclose a combination of the limitations of claim 13 for at least the above reasons. Claim 13 is thus believed to be patentable over Ciccarelli.

Therefore, it is respectfully requested that the rejection of claims 12 and 13 under 35 U.S.C. § 102(e) be withdrawn.

Rejection of Claims 1-4, 6-8, 10-11 and 14

Claims 1-4, 6-8, 10-11 and 14 were rejected under 35 U.S.C. § 103(a) as being obvious over Ciccarelli in further view of Anderson. In light of the amendment to claims 1-4, 7, 8, 10 and 11, applicant respectfully requests for the Examiner's reconsideration and further examination of the claims in view of the remarks below.

Ciccarelli is directed to compensation of mismatch in I and Q output signals in a low or zero intermediate frequency receiver. More specifically, Ciccarelli discloses a system 100 that includes mixers 20, 22, low pass filters 24, 26, and an I-Q compensation circuit 150 that generates compensated versions of the signals I(t) and Q(t) (Figure 5 and paragraph 18). The mixers 20, 22 receive a RF modulated signal and an I local oscillator signal and a Q local oscillator signal, respectively, and the outputs of the mixers 20, 22 are filtered by the low pass filters 24, 26, respectively, to generate the I and Q output signals (Figure 5, paragraphs 53-54 and Abstract). The correction circuit 150 applies a correction factor to at least one of the I and Q output signals to correct gain and/or phase error by applying a multiplication factor to the at least one of the I and Q output signals to generate a corrected signal (paragraph 18).

There is, however, no disclosure, teaching or suggestion in Ciccarelli that the compensation circuit 150 estimates the phase or gain imbalance and compensates the I and Q output signals using a value related to a cross correlation of the I output signal and the Q output signal. There is also no disclosure, teaching or suggestion in Ciccarelli that the compensation circuit 150 estimates the phase or gain imbalance and compensates the I and Q output signals using a value related to a cross correlation of a compensated version of the I output signal and a compensated version of the Q output signal. Further, there is no disclosure, teaching or suggestion in Ciccarelli that the compensation circuit 150 estimates the phase or gain imbalance and compensates the I and Q output signals using a value related to a square of a compensated version of the I output signal and a square of a compensated version of the Q output signal. Although Ciccarelli discloses calculating the correction factor with a matrix shown in equation (5), the mathematical calculation of equation (5) is nevertheless not related to a cross correlation of the I output signal and the Q output signal, a cross correlation of a compensated version of the

I output signal and a compensated version of the Q output signal, or a square of a compensated version of the I output signal and a square of a compensated version of the Q output signal.

Amended claim 1 recites, *inter alia*, a receiver comprising means for estimating the phase imbalance or gain imbalance prior to symbol synchronization and for providing estimated and compensated I and Q components of an incoming I/Q modulated signal for symbol synchronization using at least one of a first value related to a cross correlation of the I component and the Q component of the modulated signal, a second value related to a cross correlation of a compensated I component and a compensated Q component of the modulated signal, and a third value related to a square of the compensated I component and a square of the compensated Q component of the modulated signal. As explained above, Ciccarelli fails to disclose a combination of the recited limitations of amended claim 1. Thus, amended claim 1 is believed to be patentable over Ciccarelli.

Amended claim 7 recites, *inter alia*, a method comprising ... compensating the phase imbalance or gain imbalance using at least one of a first value related to a cross correlation of the I component and the Q component of the modulated signal, a second value related to a cross correlation of a compensated I component and a compensated Q component of the modulated signal, and a third value related to a square of the compensated I component and a square of the compensated Q component of the modulated signal such that a feed-forward scheme or a feed-back scheme is established. As explained above, Ciccarelli fails to disclose a combination of the recited limitations of amended claim 1. Thus, amended claim 1 is believed to be patentable over Ciccarelli.

Amended claim 11 recites, *inter alia*, a computer readable storage medium storing instructions that, when executed, estimate or compensate phase imbalance or gain imbalance in a receiver utilizing a QPSK modulation and a modulation scheme based on complex scrambling code according to a method comprising ... providing estimated and compensated I and Q components of an incoming I/Q modulated signal for symbol synchronization using at least one of a first value related to a cross correlation of the I component and the Q component of the modulated signal, a second value related to a cross correlation of a compensated I component and a compensated Q component of the modulated signal, and a third value related to a square of

the compensated I component and a square of the compensated Q component of the modulated signal. As explained above, Ciccarelli fails to disclose a combination of the recited limitations of amended claim 1. Thus, amended claim 1 is believed to be patentable over Ciccarelli.

Anderson is directed to demodulation of coherent and non-coherent modulated signals. More specifically, Anderson discloses a processor 20 that demodulates the digital carrier signals and provides I and Q outputs to symbol synchronization circuit 22 and interpolate circuit 24 (Figure 3; col. 6, lines 18-24). However, Anderson fails to remedy the deficiencies of Ciccarelli as Anderson too fails to teach or suggest a combination of the limitations recited in claims 1, 7 and 11. There is simply no disclosure, teaching or suggestion in Anderson of estimating or compensating phase or gain imbalance in I and Q components of a modulated signal using at least one of a first value related to a cross correlation of the I component and the Q component of the modulated signal, a second value related to a cross correlation of a compensated I component and a compensated Q component of the modulated signal, and a third value related to a square of the compensated I component and a square of the compensated Q component of the modulated signal.

Thus, Ciccarelli and Anderson, whether singly or in combination, fail to disclose the recited limitations of amended claims 1, 7 and 11. For at least this reason amended claims 1, 7 and 13 are believed to be patentable over Ciccarelli in view of Anderson.

Claims 2-4, 6, 8, 10 and 14 are believed to be patentable over the cited reference because of their respective dependency on patentable independent claims 1 and 7, respectively, and because of the additional limitations recited by those claims.

For example, claim 2 recites wherein the first value is a ratio between a cross correlation of said I and Q components of the incoming I/Q modulated signal and a mean value of a square of the I component, wherein the second value is a ratio between the cross correlation of the compensated I and Q components and a square root of a product between a mean value of the square of the compensated I component and a mean value of a square of the compensated Q component, and wherein the third value is a ratio between the mean value of the square of the compensated Q component and the mean value of the square of the compensated I component.

There is no disclosure, teaching or suggestion in either Ciccarelli or Anderson of a ratio between a cross correlation of said I and Q components of the incoming I/Q modulated signal and a mean value of a square of the I component, a ratio between the cross correlation of the compensated I and Q components and a square root of a product between a mean value of the square of the compensated I component and a mean value of a square of the compensated Q component, or a ratio between the mean value of the square of the compensated Q component and the mean value of the square of the compensated I component.

As another example, claim 8 recites determining at least one first ratio selected from the group consisting of a second ratio, a third ratio and a fourth ratio, wherein the second ratio is a ratio between a cross correlation of I and Q components of an incoming I/Q modulated signal and a mean value of a square of the I component, wherein the third ratio is a ratio between the cross correlation of the I and Q components and a square root of a product between a mean value of the square of the I component and a mean value of a square of the Q component, and wherein the fourth ratio is a ratio between the mean value of the square of the Q component and the mean value of the square of the I component. There is no such disclosure, teaching or suggestion in either Ciccarelli or Anderson.

Therefore, it is respectfully requested that the rejection of claims 1-4, 6-8, 10-11 and 14 under 35 U.S.C. § 103(a) be withdrawn.

Rejection of Claims 5 and 9

Claims 5 and 9 were rejected under 35 U.S.C. §103(a) as being obvious over Ciccarelli in view of Anderson, in further view of Zheng. The rejection of claim 9 is moot as claim 9 was canceled in a previous amendment.

Zheng is directed to a fully integrated self-tuned image rejection down-conversion system. In particular, Zheng discloses a self-tuning image rejection down-conversion system quadrature I and Q mixers 10a, 10b, a complex filter signal extractor 20, and a feedback path composed of correlator 30, a gain mismatch estimator 40 and a compensator 50.

As explained above, Ciccarelli and Anderson fail to disclose a combination of the recited limitations of independent claim 1. Zheng fails to remedy such deficiencies as Zheng also fails to disclose a combination of the recited limitations of claim 1. For example, among

other things, there is no disclosure, teaching or suggestion in Zheng of estimating or compensating phase or gain imbalance in I and Q components of a modulated signal using at least one of a first value related to a cross correlation of the I component and the Q component of the modulated signal, a second value related to a cross correlation of a compensated I component and a compensated Q component of the modulated signal, and a third value related to a square of the compensated I component and a square of the compensated Q component of the modulated signal.

Thus, Ciccarelli, Anderson and Zheng, whether individually or in combination, fail to disclose the recited limitations of amended claim 1. Amended claim 1 is thus believed to be patentable over Ciccarelli in view of Anderson in further view of Zheng.

Claim 5 is believed to be patentable over the cited reference because of its respective dependency on patentable independent claim 1, and because of the additional limitations recited by claim 5. Therefore, it is respectfully requested that the rejection of claim 5 under 35 U.S.C. § 103(a) be withdrawn.

Rejection of Claim 15

Claim 15 was rejected under 35 U.S.C. 103(a) as being obvious over Ciccarelli in further view of Anderson, in further view of Zheng.

As explained above, Ciccarelli, Anderson and Zheng, whether individually or in combination, fail to disclose a combination of the recited limitations of amended claim 1.

Claim 15 is believed to be patentable over the cited reference because of its respective dependency on patentable independent claim 1, and because of the additional limitations recited by claim 15. Therefore, it is respectfully requested that the rejection of claim 15 under 35 U.S.C. § 103(a) be withdrawn.

Conclusion

Overall, the cited references do not singly, or in any motivated combination, teach or suggest the claimed features of the embodiments recited in independent claims 1, 7, 11, 12 and 13, and thus such claims are allowable. Because the remaining claims depend from allowable independent claims 1, 7, 11, 12 and 13, respectively, and also because they include

additional limitations, such claims are likewise allowable. If the undersigned attorney has overlooked a relevant teaching in any of the references, the Examiner is requested to point out specifically where such teaching may be found.

In light of the above amendments and remarks, Applicants respectfully submit that all pending claims are allowable. Applicants, therefore, respectfully request that the Examiner reconsiders this application and timely allow all pending claims. Examiner Shah is encouraged to contact Mr. Han by telephone to discuss the above and any other distinctions between the claims and the applied references, if desired. If the Examiner notes any informality in the claims, he is encouraged to contact Mr. Han by telephone to expediently correct such informalities.

The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

Respectfully submitted,

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